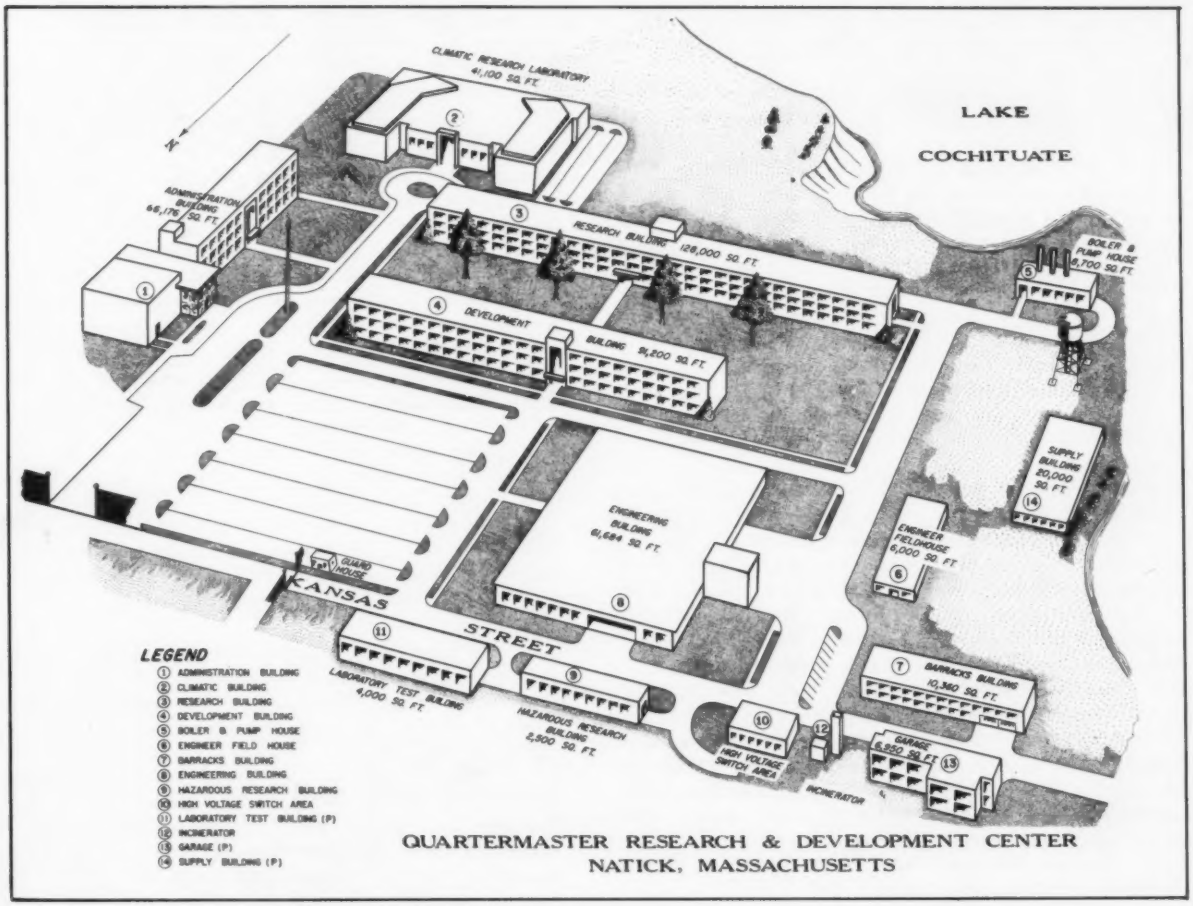
ENVIRONMENTAL QUARTERLY

Vol. 1, No. 1 Fall 1955



Published by the Environmental Equipment Institute, 30 Church Street, New York 7, New York

ENVIRONMENTAL EQUIPMENT INSTITUTE

Environmental simulation and testing, a young and growing field, borders upon several areas already well marked out and defined by other groups and publications. But its problems and techniques are distinctly different. Although related to mechanical engineering, refrigeration engineering, instrumentation, industrial research, and many others, it is none of these. It stands by itself, and no other currently established society or publication can offer it a satisfactory home.

That is why the Environmental Equipment Institute, starting from meager beginnings, has steadily grown. That is why this first issue of the Environmental Quarterly, modest and unassuming as an initial venture, has a brilliant future. We are proud of this first issue, because it represents the culmination of a lot of planning and a lot of work. We are proud, too, because of the quality of the contributions which we have been able to assemble for it.

Far greater than our pride is our faith in the future of this publication. We have barely scratched the surface in contacting those who need a publication like this. This first issue is going to be the first real sign to many engineers that the Institute means business, and the first evidence of what a publication exclusively serving environmental testing and simulation can mean to them and their work. We are counting on generating a flood of support with this issue. If we are right, the Quarterly will become the full-grown professional publication it deserves to be.

The origin and early growth of any organization always reflects the efforts of a dedicated few. The Environmental Equipment Institute is no exception. Started a little more than two years ago by a small group of environmental test equipment manufacturers, its growth at times has been discouragingly slow. Several times the founders have been on the verge of giving up, because the support they expected did not materialize. More than once they questioned whether the country was ready for what they wanted to do. Their discouragement was always offset by an active interest in what the Institute planned to do. The Institute has never had an active publicity program. Its public announcements have been sporadic, yet our office has been receiving a steady flow of inquiries. We know that interest is keen, even though support has been slow in forthcoming.

But the picture is changing. The First Annual Science Meeting drew nearly 175 scientists and engineers. Out of that number came the nucleus of the Science Section Steering Committee, whose activities you may read about in the pages that follow. This group has enthusiasm to match that of the founders. The Quarterly is largely the product of their ideas and moral support. So, too, are the plans for a bigger and better science meeting next spring. In short, this handful of enthusiastic members has succeeded in putting some punch into the program which the founding companies got under way.

Dedicated souls are fine. We cannot get along without them. Neither can we get along without wholehearted moral and financial support from the group we are trying to serve. We could have published Volume 1, Number 1 of the Environmental Quarterly a year ago. We could have the projected Handbook of the Environment in your hands right now. We have not been able to do so because we do not have the financial resources. People have been waiting to see what we would do before deciding to join us.

We have had a successful Science Meeting. Now we have a magazine. We have done this with a pitiful budget, because the work was needed. Now is the time for everyone in the field to act. If you like this magazine and if you liked the program of the First Annual Science Meeting, then join us. We need Science Members and company Science Members. We need Manufacturing Members. Put your shoulder to the wheel and help us push. Who knows how far we can go?

GEORGE D. WILKINSON
General Manager
Environmental Equipment Institute

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Ours is a young organization and the people who join now will have the rare opportunity of being able to help form the organization so that a maximum of benefit can be derived by all. Join now - you need the Science Section and it needs you. Application blanks can be obtained from:

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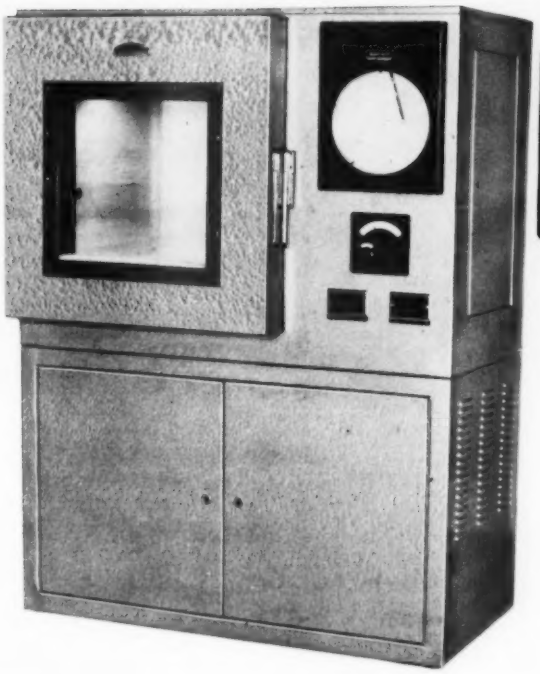

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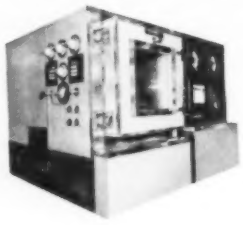

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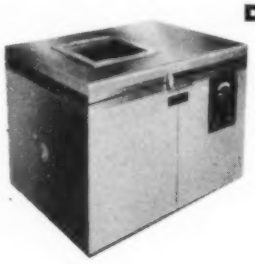

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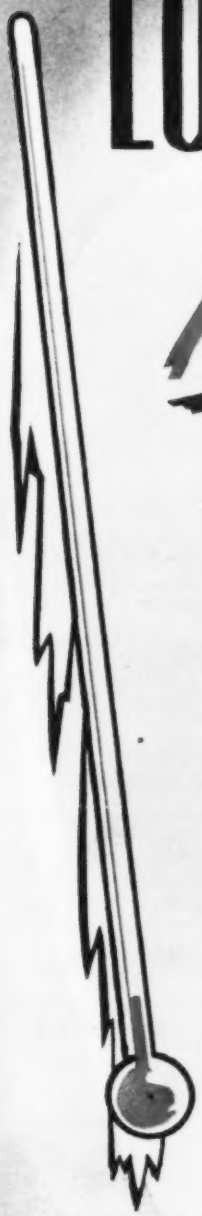

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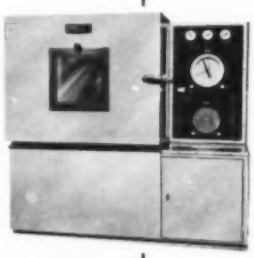

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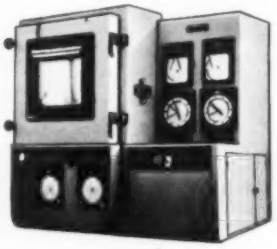

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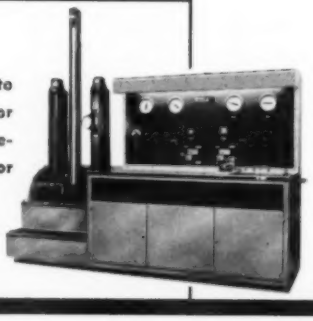

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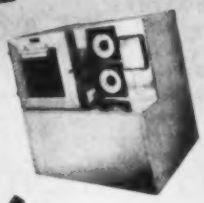
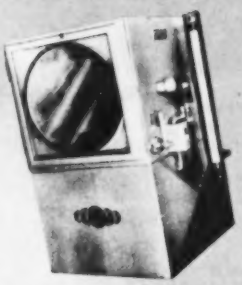

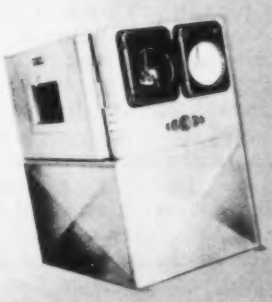
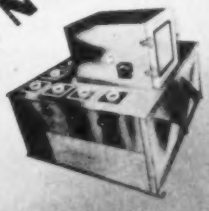

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SCIENCE SECTION MINUTES

The first meeting of the Steering Committee of the Science Section of the Environmental Equipment Institute was held on Wednesday, July 6, 1955, at the Hotel Sheraton, Chicago. Those in attendance were: Roger J. Amorosi, Parameters, Inc.; Earle G. Foote, Boeing Airplane Co.; Harold C. Jones, Westinghouse Electric Corp.; Newell Mecartney, Jack & Heintz, Inc.; H. F. Sander, Vapor Heating Corp.; and George D. Wilkinson, General Manager, Environmental Equipment Institute.

Dr. Wilkinson opened the meeting by giving a brief history of the Institute and describing the activities of the Science Section. He stated that the First Annual Science Meeting, held last April in Chicago, had been sponsored by the Manufacturing Members and entirely planned and executed by his office. He added that the time had now come for the Science Section to begin to think about becoming self-supporting and planning its own activities. The Manufacturers, he explained, were genuinely interested in the formation of an autonomous group which could share with them the responsibility for establishing environmental testing on a sound technical and scientific basis. Although most of those who have joined the Science Section, or have expressed an interest in doing so, are intent upon reaping benefits without contributing more than the required financial support, every organization needs a group which is willing to put its shoulder to the wheel and get things going. He expressed the hope that this would be such a group for the Science Section.

The group held an informal discussion of their aims and the aims of the Science Section, and agreed that it was willing to assume the responsibility of acting as a steering committee to serve until such time as an organization could be established.

The first matter discussed concerned the organization of the Science Section. It was generally agreed that it should consist of a central governing body which would have the power to authorize the formation of local sections. A member need not be affiliated with a local section. This is in distinction to the concept of some professional societies, in which the local groups are autonomous and the central body represents only a federation of local bodies for handling matters of common interest. Tentatively an organization was established consisting of the following officers: Chairman, Executive Vice Chairman, Vice Chairman in Charge of Meetings, Vice Chairman in Charge of Membership and Local Sections, Vice Chairman in Charge of Publications, Secretary-Treasurer (only paid officer, with voice, but no vote) and Counsel.

The Board of Directors would consist of the above officers plus the following Directors: one Director representing private industry (users only), one Director representing government agencies and one Director representing each authorized local section.

The question of Membership and Membership dues was next discussed. Dr. Wilkinson pointed out that the Charter of the Institute vested the power to assess dues in the Executive Committee of the Institute, but said that this group could recommend a dues schedule. He said he felt sure that the Executive Committee would be glad to consider such recommendations. After discussion it was agreed that within the definitions given in the Charter and By-Laws, the Science Section could recognize distinctions in membership.

The following classifications of membership within the Science Section, and dues schedule were agreed upon:

1. Regular Members: Any person interested in environmental testing and simulation is eligible to become a regular member of the Science Section. Regular Members will be entitled to receive free copies of Institute publications, to special Members' rates for Institute functions, and to a vote in Science Section meetings. Dues for Regular Members will be $20.00 per year.

(Continued on Page 14)

Army Seeks Answers To Human Stress Problems At Natick Environmental Lab

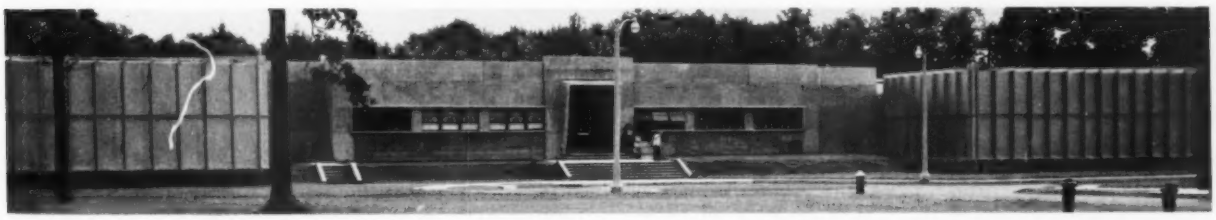
Dr. Austin Henschel, Chief, Environmental Protection Division, Quartermaster Research and Development Center, Natick, Mass.

The mission of the Environmental Protection Division of the new Quartermaster Research and Development Center, Natick, Mass. is to devise means of nullifying some of many stresses that constantly impinge upon the soldier while operating under global climatic conditions. In our present state of knowledge, it is usually impossible to describe the way the soldier will react to these combined stresses or to estimate the extent of the effect of these stresses upon his effectiveness. Anything that can be done to strengthen the resistance of the average individual to forces that reduce his efficiency will raise the performance of the vast majority which, in the end, must turn the tide of battle.

The data derived from research activities are used to solve problems of subsistence, services, and the design of improved items of clothing and equipment. In some instances, the research may lead quite directly to improvements and modifications in already existing items such as load-carrying equipment, sleeping bags and footwear. In other instances, the results may furnish a basis for assessing requirements and pointing out basic needs. In still other instances, the results of research may be applied to the conception, design and operation of personal equipment.

Although much of the research is directed -- i.e., it is designed to answer some specific question or furnish data for improvement of some item -- fundamental research is constantly encouraged. Close liaison between groups concerned with research work and groups involved in design and development is maintained so that newly available information may be utilized as quickly as possible.

Seldom are stresses applied independently under combat conditions -- the usual situation is a simultaneous application of a number of stresses, each of which has its primary effect, and each of which influences the effectiveness of the other. In combat in the cold, the major stresses that the soldier encounters may be (1) nutritional, (2) climate, (3) overwork, (4) inadequate sleep, (5) emotions and (6) unsuitable equipment. Each one of these, for example, may influence the development of frostbite of the feet: nutrition, by its effect on heat production; climate, by causing vasoconstriction and freezing; overwork, by its effect on heat production or heat loss by its influence on vascular control; inadequate sleep, by its effect on alertness to impending tissue damage; emotion, as it produces peripheral vasoconstriction, and influences acceptance and the intelligent use of equipment. Improperly designed equipment may in itself alter the physiological responses of the man.



The 232' x 190' Climatic Building which houses Arctic and tropic climatic chambers and specialized equipment of the Environmental Protection Division. Within the climatic chambers it is possible to simulate temperatures, precipitation, and wind velocities characteristic of any climate.

One of the most important, and certainly one of the most difficult and time-consuming problems, is the development of methods and procedures to evaluate the impact of a stress or combination of stresses upon man. What measurements can one devise to determine that stress has been translated into physiological strain? What responses to stress can be used as indices for the purpose of quantitation of the impact of the stress? Of great practical importance are the ways in which one can use the knowledge of specific and nonspecific stress responses to design and develop better clothing, rations and personal equipment.

An important task for the technologists is to apply physiological knowledge to military clothing problems. For example, a major problem in Arctic clothing is the protection of the soldier regardless of his activity. A uniform that would keep a sedentary soldier (e.g., on guard duty) warm at -40F might have several disadvantages if he had to go into sudden activity. It would probably be too cumbersome for one thing and in addition the increase in his metabolism would result in overheating, with profuse sweating. Due to the heavy clothing the sweat could not evaporate readily and this would lead to further overheating, thus initiating a vicious circle. As the clothing became wet it would lose its insulative properties so that when the soldier ceased his activity the uniform would no longer effectively keep him warm, in addition to which, any moisture trapped in the clothing would freeze, making him colder still. Thus, in the above situation the sweating process, which is the most effective protection against overheating, can be more of a threat to the soldier than enemy action. This points up a little realized paradox: the problem in Arctic clothing is as much the protection against overheating as it is against freezing. Efforts are continually being made to overcome this problem by use of different textiles and other materials which will provide greater insulation with less bulk; by altering the design of Arctic clothing to permit readier evaporation of sweat; and by use of vapor impermeable barriers near the skin to prevent sweat from wetting the clothing.

The soldier, right, seen through the window of the Arctic climatic chamber, is testing Army cold weather clothing and is, at the same time, the subject of a physiological study to determine the effects of prolonged exposure at -40F. The soldier speaking into the intercom is recording the comments of the test subject.

Another problem of great importance is hand and foot protection. Fingers and toes are mostly skin, bones and tendons, their sole source of heat being the warm blood. Since there is a considerable reduction in finger blood flow in the cold, there are definite limits to the length of time a sedentary soldier's hands can be protected. If clothing could be designed that would maintain the flow through the hands, despite nature, great benefits would result. It is only by fuller knowledge of the physiological factors involved that a rational approach can be made.

Protecting the soldier against cold-wet climate has long been a problem. From a physiological point of view very little is known about why cool, damp weather chills one "to the bone". The availability of the new climatic chambers at the Natick Quartermaster Research and Development Command will make it possible to discover what aspects of physiological responses to cold-wet should be taken into account in designing clothing for these conditions.

The Environmental Protection Division utilizes both laboratory and field research in the attack on problems of the individual soldier and his equipment. Although it is recognized that both methods have inherent disadvantages, these disadvantages are not the same, and it is possible to obtain reasonably definitive results when field and laboratory research are used to complement each other.

The new climatic chambers at the Quartermaster Research and Development Center have created opportunities for refinements in techniques for the study of man when exposed to extreme environments. The chambers provide control over wind velocity, humidity, precipitation and solar and long-wave radiation. (See Table opposite page.)

There are two treadmills in both the arctic and tropic chambers with capacities of four fully equipped men per treadmill. Each treadmill is adjustable from 0 to 12% grades at speeds from 1.5 to 15 mph. In addition to the Arctic and tropic chambers, there is an Arctic conditioning room with temperature

range from -70F to 70F; a tropic conditioning room with temperature range from 0 to 165F; and two dressing rooms with temperature ranges from plus 60F to 80F. Facilities for housing and feeding test subjects under controlled conditions are provided through the media of a 12-man dormitory and a diet kitchen.

Weather Element	Arctic Chamber 15' x 60'	Tropic Chamber 15' x 60'
Temperature	-70 to 70F (*)	0 to 165F
Humidity	-70 to 0F; No Control 0 to 70F; 10-90% RH	125 to 165F; No Control 0 to 125F; 10-90% RH
Wind Velocity	-70F; 2-5 mph -60F; 2-10 mph -50F; 2-28 mph -40 to 70F; 2-40 mph	0 to 110F; 2-40 mph 120F; 2-30 mph 130F; 2-20 mph 140F; 2-5 mph
Rainfall	Area 15' x 20' 10 gal/min Will produce 4"/hr	Area 15' x 20' 10 gal/min Will produce 4"/hr
Snowfall	Any reasonable depth	Any reasonable depth
Solar Radiation	Portable 15' x 20' panel	Portable 15' x 20' panel
Long Wave Radiation	Portable 15' x 20' panel	Portable 15' x 20' panel

(*)Fahrenheit Dry Bulb

Among the highly specialized equipment at Natick is the Copper Man.

The Copper Man is used primarily for measuring the insulating value of clothing or sleeping gear. Essentially, it is an electrically heated hollow copper shell with external configuration like that of an average young male soldier. The outer surface is painted flat black to duplicate the ability of human skin to exchange radiation with the surroundings.

Inside the shell are numerous wires for heating the manikin, controlling temperature and measuring it at any one of twenty locations. The heating wires are sewn to cloth carriers which are in turn connected to the inside of the shell. The spacing of these wires is such that the temperature pattern at the surface of the manikin can be made similar to that of a human at rest in a comfortable environment. The temperatures of the hands and feet are independently adjustable to permit simulating the effects of vasoconstriction in a man with inadequate protection. The control circuit in each manikin consists of a series of temperature sensitive resistance elements (thermistors) which operate an on-off controller in the electrical supply circuit. Each element is imbedded in wax in a .32 caliber cartridge shell pressed through a hole in the shell. Thermocouple elements for surface temperature measurement are similarly mounted in .22 caliber cartridges.

In a typical study, the manikin is dressed, placed in a constant temperature environment, and heated to a normal surface temperature of, say, 92F average. Since the Copper Man does not sweat, the environment must be cooler than its surface. Otherwise no electrical energy would be required. The manikin is normally operated at a constant temperature which means that energy will be supplied electrically as fast as heat escapes from the surface via the clothing under study. It is a relatively simple matter to maintain close control of surface temperature and electrical input, hence heat loss can be measured accurately with this method. An on-off temperature controller is customarily used with the manikin, with the on cycle monitored by running time meters.

Although the fact that the manikin does not sweat limits its usefulness, it has been of tremendous help in providing data in problem areas where the effects of cooling by sweat evaporation are not involved. One such area was in determining the effect of wind on the insulating value of Arctic clothing. Prior to the Copper Man such a determination was not possible since it would have required exposure of human subjects in temperatures down to minus 40F with winds up to 20 mph for periods much longer than a man could endure.

In addition to this type of study, the Copper Man is useful for routine measurement of insulation during the development of new clothing assemblies or sleeping bags. These measurements, conducted under laboratory conditions; quickly indicate deficiencies in insula-

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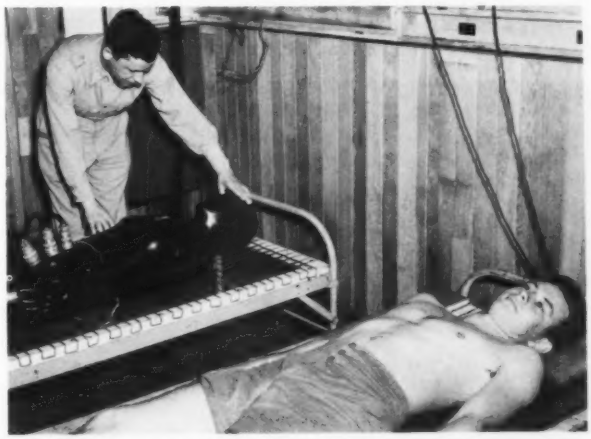


Test subject and copper man are exposed to same conditions to determine relative skin temperatures and heat loss. Amount of electrical energy needed to maintain surface temperature of copper man at same levels as skin temperatures of test subject determines heat loss with various clothing ensembles under various conditions.

SIMPLE METHOD DETERMINES CROSS SENSITIVITY IN LINEAR ACCELEROMETERS

Method Evaluates Side Sensitivity and Lateral Component of Applied Force

EARLE G. FOOTE
BOEING AIRPLANE COMPANY

In the application of linear accelerometers it is often desirable to discriminate between and measure the acceleration components directed along 3 mutually perpendicular axes. In order to accomplish this the accelerometer should have negligible sensitivity to accelerations in any direction other than its input axis. However, this is not true of any commercially available accelerometers to the writer's knowledge and therefore the sensitivity of the accelerometer to accelerations directed along axes other than its input axis must be measured. This quantity will be defined as cross sensitivity of the accelerometer.

Determination of cross sensitivity has in general been accomplished by mounting the accelerometer rigidly upon a vibration table with the sensitive axis of the accelerometer perpendicular to the direction of the applied force. Satisfactory results are obtainable only when the vibration table has negligible lateral and angular motion.

The following procedure may be used to evaluate the side sensitivity of the accelerometer and also to determine the lateral component of the applied force.

A fixture that can be rotated about an axis parallel to the direction of the applied force is used. The accelerometer is mounted on the fixture with sensitive axis perpendicular to the applied force as shown in Fig. 1, and the entire assembly to mounted upon a vibration table which is driven at a constant frequency and acceleration. When the fixture is rotated in convenient steps, the accelerometer output follows the relation $K_1 K_2 G + K_2 S \cos\theta$, where:

K_1 = Cross sensitivity of the accelerometer

K_2 = Sensitivity of the accelerometer

G = Exciting acceleration

S = Lateral acceleration of the vibration table

θ = Angle of rotation of the fixture

The curve when plotted appears as a sine function raised above zero as shown in Fig. 2. The average value is the output due to the cross sensitivity of the accelerometer, and the deviation of the crest from the average value is the output due to the lateral acceleration of the vibration table.

This equation is valid only if the sensitive axis of the accelerometer is perpendicular to the direction of the exciting force, and the observed output of the accelerometer is free of second harmonics. The occurrence of second harmonics indicates that the accelerometer is being excited with some angular accelerations, or that the driving force contains second harmonics. Either of these causes are undesirable for precision evaluation.

(Continued on Page 16)

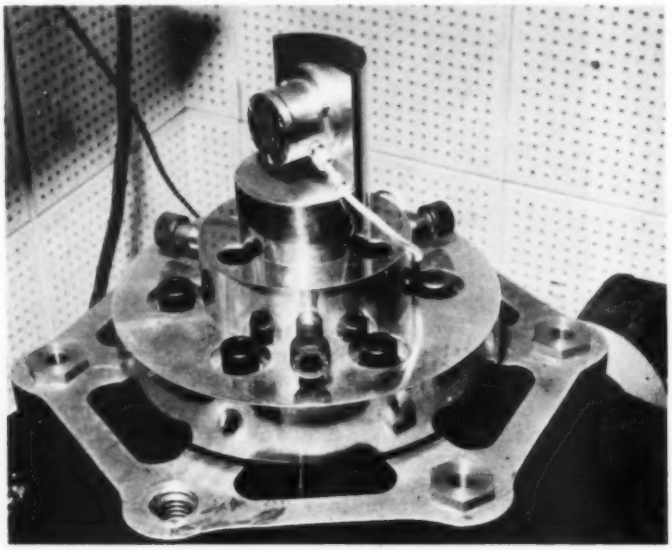


FIG. 1

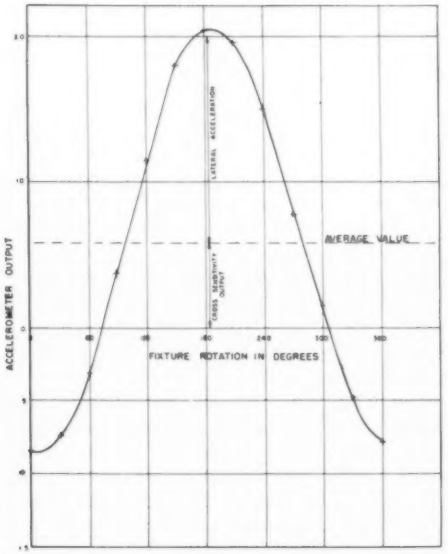


FIG. 2

EMBOSSED PANELS

by Rubin Raskin

Dean Products, Inc.

Brooklyn 38, New York

Embossed panels are heat exchange surfaces, fabricated by embossing flow patterns in sheet metal. Two mating embossed sheets, or one embossed and one flat sheet, are welded together in the debossing and around the edges to close the passageways.

These panels are used with refrigerants and liquid coolants, and also with steam and other fluids for heating.

There are many ways in which embossed panels may be used, due to the fact that they may be shaped, fabricated, and assembled, almost as if they were sheet metal.

Their outstanding use in environmental test equipment is in the construction of rectangular chambers, such as those shown in Fig. 1, where the liner is fabricated of these plates. Plates generally are welded into the liner. In those cases where altitude services are required, reinforcings are used to prevent the side walls from buckling under atmospheric pressure. The reinforcing network generally is welded directly to the outside of the embossed plates. In some cases, where it is not practical to make the chamber walls of the embossed plates (in masonry construction or in very large rooms, for example) the plates may be mounted around the walls, on the ceiling and floor, and may be attached by bolts, clips, or other means.

The embossed plates also are suitable for use as heat exchange banks with fans where 100% prime surface is used, as shown in Fig. 2. They serve as baffles in cold traps to provide directed air flow, as well as condensing and cooling surfaces, as shown in Fig. 3. Cold plates also are used as the walls or liners of cylindrical chambers for cold traps.

Embossed panels serve a dual purpose by providing both the liner and the heat exchange surface in an integral unit. They are relatively light, yet because of the corrugated and assembled nature, have a very high strength-to-weight radio.

In the case of altitude chambers, considerable savings may be effected because, as the altitude increases, the means available for heat transfer become limited primarily to radiation. Embossed plates provide flat heat exchange surfaces with flexibility of location which make them desirable for this type of application.

For example, an altitude chamber with a 3' x 3' x 3' working space capable of maintaining a temperature of approximately -85F would require an air handling capacity in the

(Continued on Page 19)

EMBOSSED PANELS...

...are rolled into cylinders, bent to form "L" shapes, rectangles, and U's...have been provided in the form of discs and doughnut-shaped rings...are welded into tanks and rectangular chambers...may be provided with penetrations and through fittings...are available with reinforcings attached for vacuum applications, or other vessels...are fabricated of various materials such as steel, stainless steel, or monel...may be fabricated of dissimilar materials as long as they are compatible for welding purposes...have been coated with various materials such as tin, aluminum, copper, nickel, chrome, and many plastics and organic coatings...have been made up in the form of clamps for binding around circular tanks and chambers...and have been made in a variety of embossing patterns and cross sections for various refrigerants and fluid mediums to provide an optimum internal volume-to-surface relationship.

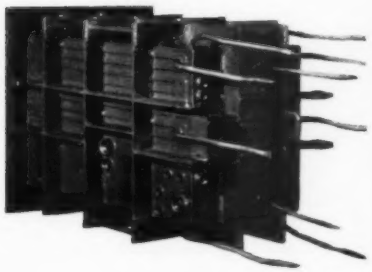


FIG. 1

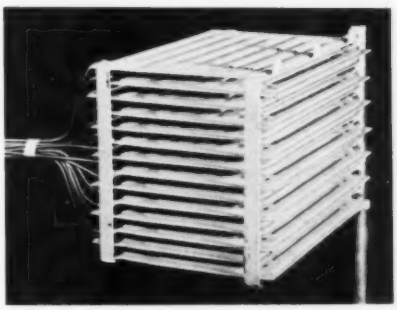


FIG. 2

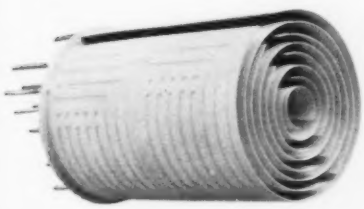


FIG. 3

(Continued from Page 8)

SCIENCE SECTION MINUTES

2. Government Agencies: Any independent government installation having an interest in environmental simulation or testing will be granted membership in the Science Section upon written request of its commanding or executive officer. Such member installations may designate a maximum of two persons to act as its representatives. These persons will receive all privileges accorded to regular members as long as they are employed by the agency and designated as members. If they terminate their connection with the agency, or their designations as representatives are withdrawn, they may transfer their status to that of Regular Members by payment of one year's dues for that classification.
3. Educators: Any person interested in environmental testing and simulation and carrying a teaching load of at least six hours a semester at an accredited institution of higher education is eligible for membership as an educator. Educators will receive all the privileges of Regular Members. The dues for Educators will be $15.00 per year.
4. Company Members: Any private company not eligible as a Manufacturing or Associate Member and having an interest in environmental testing and simulation is eligible to become a Company Member. Such companies will receive three copies of all Institute publications and will be entitled to send up to five employees to any Institute function at the Member rates. Dues for Company Members will be $100.00 per year.

   Employees of Manufacturing Members who wish to participate in the affairs of the Science Section are eligible to become Regular Members upon payment of the annual dues.

   All applications for membership in the various grades within the Science Section are subject to the approval of the Science Section Membership Committee, and may be rejected by that Committee for sufficient cause.

It was decided that local sections of the Institute would have to submit their constitutions and by-laws to the governing committee of the Science Section for approval as a condition for affiliating with the Institute. Headquarters of the Institute is to offer as much assistance as possible in the setting up of local sections, but each section is to become self-sufficient as soon as possible. A rebate of 10% on all dues paid by members of a local section will be made to help finance section activities.

It was decided that no initiation fee would be charged for anyone joining the Science Section before the Second Annual Meeting.

It was decided that a Second Annual Science Meeting would be held at the Hotel Sheraton in Chicago, and that it would be a two day affair. The date was set for April 19 and 20, subject only to the proviso that it does not conflict with religious holidays. The meeting is to have two luncheons of quality comparable to the one last year, but no banquet. The program is to include facility visits, general talks, especially aimed at beginners, seminars for advanced workers, exhibits and films for empty spots in the program.

GET YOUR SCIENCE SECTION

APPLICATION BLANK NOW!!!

write to:
Environmental Equipment Institute
30 Church Street
New York 7, N.Y.

Registration fees were set as follows:

	Members	Non-Members
One Day	$12.50	$17.50
Both Days	$20.00	$30.00

It was decided to hold the first election for officers of the Science Section as soon as there were one hundred active dues-paying Science members.

At the conclusion of the meeting, the following temporary assignments of responsibility were made: Henry Sander - Meeting Chairman; Earle Foote - Publication Chairman; Harold Jones - Membership and Local Section Chairman; Newell Mecartney - Nominating Committee Chairman; Roger Amorosi - Budget and Finance Chairman.

The entire group will act as a steering committee until a formal organization and elections can be held.

These minutes have been approved in toto by the Executive Committee and constitute the current program for the Science Section.

Respectfully submitted:

GEORGE D. WILKINSON
General Manager

(Continued from Page 11)

tion which would otherwise not be detected until field studies were conducted.

A new method for determining the total amount of fat (adipose tissue) in the body of living subjects is being investigated with an air-tight respirator (iron lung) in which subjects are placed. By measuring the air pressure in the respirator which is called BOVOC (Body Volume Calculator), it is possible to determine the body volume of any man or woman. With this information the relative amount of fat in the individual expressed as a percentage of weight can be calculated.

The amount of adipose tissue in the soldier is an important factor in determining his response to heat and cold. The fatty layer which protects against the cold temperatures becomes an unfavorable characteristic in the heat where an insulation makes the soldier more susceptible to heat stress. There are several known methods of establishing body fat, but the BOVOC offers certain advantages in military research: portability and rapid handling of large numbers of individuals.

A major effort is being directed toward the monitoring of the Army-wide Envanal project. This project is aimed at developing a practical system for the rapid comparison of critical environmental factors with equipment performance. An outline Envanal system for matching equipment to environment has been completed, and a prototype is now being constructed. Work to date has brought out the need for more information on item performance as well as for methods for analyzing and numerically expressing geographical and climatological factors, so that the mechanism of equipment failure will be better understood.

Study is also being conducted of environmental elements that have an impact upon the storage and operation of military equipment and their role in determining the physical conditions in which Army personnel live and fight. Stresses caused by the elements usually considered (precipitation, temperature and humidity) do not always add up to the total environmental stress, and research is being carried out on such other factors as solar radiation, ozone, hail, glaze and dust. The total environmental stress is composed of the meteorological elements in conjunction with the physical conditions of the earth's surface.

The Environmental Protection Division also is concerned with the delineation of the physiologic and psychologic maxima and minima within which man can maintain his effectiveness under the stresses of Army duties and with the development and design of such items of clothing, food and equipment as will allow the man to keep within safe limits while undergoing the stresses imposed upon him.

QUESTIONS AND ANSWERS

The Questions & Answers column will be a continuing feature of your Environmental Quarterly. Address questions and answers to the Environmental Equipment Institute, 30 Church St., New York 7, N.Y.

Question:

In establishing the operational limits on a proposed environmental test facility, the following question has presented itself:

At 100,000 feet, the absolute pressure is 7.8 mm of mercury, and at 200,000 feet the absolute pressure is 0.2 mm of mercury. If a piece of equipment (especially electronic equipment) is capable of operating from sea level to 100,000 ft (a pressure difference of 752.2 mm of mercury), is there any reason to believe that the additional decrease of 7.6 mm will cause the equipment to fail?

If the answer to this question is in the negative, a great deal of money may be saved or diverted to improvement in other parameters by not specifying a facility capable of 200,000 ft of altitude.

H. C. Jones, Westinghouse Electric Corp.

Answer No. 1:

As a generality, theoretical prediction of the effect of any environmental condition upon equipment (particularly electronic equipment) is a dangerous practice. There are any number of cases on record in which test evaluation of the effect of environmental conditions on equipment has yielded results which could not possibly have been predicted on a theoretical basis. However, since this question refers only to the effect of variations in atmospheric pressure, some techniques short of full scale 200,000 ft simulation may be practical. The main problems created by the reduction in pressure would probably result from increased gas ionization, decreased heat dissipation and the effect of "vacuum" conditions on hermitic seals. An estimation of the importance or magnitude of these effects could take the form of "bell jar" evaluation of individual components (vacuum tubes, condensers, etc.)

The results of this evaluation would probably serve to indicate whether or not simulation of 200,000 ft altitude on electronic equipment is in general necessary.

Mel Ramberg, Parameters, Inc.

(Continued Next Page)

Answer No. 2:

The additional decrease of 7.6 mm of mercury in absolute pressure when going from 100,000 to 200,000 ft of altitude may be the most critical as regards to the operation of electronic equipment.

For most effects, data can be extrapolated into regions of lower pressures until mean free paths approach the physical dimensions of the component parts of an assembly. At this point, the nature of effects becomes radically changed. At 0.2 mm of mercury, we are approaching but not reaching this condition. However, even though data may be extrapolated, it is quite certain that it cannot be linearly extrapolated. We are therefore stuck with a new problem -- that of establishing the proper methods for data extrapolation.

The objective of reducing test facility requirements is always desirable from an operational as well as original cost consideration. It would appear reasonable to suggest that at least one facility is required to establish test requirements and data extrapolation means for this region. This facility should be provided in sufficient lead time to enable the completion of the above work prior to purchasing schedules for environmental test facilities.

Earle G. Foote, Boeing Airplane Co.

Answer No. 3:

I feel that there is no reason for the equipment to fail electrically due to the decrease of 7.6 mm of mercury change in pressure; however, there is nothing to substantiate as to whether the equipment would fail physically due to this change in pressure. It is possible that leakage may occur; thus causing electronic equipment to fail.

From an economical viewpoint, it probably would be easier to check components in a small chamber for the test of 200,000 ft altitude to determine the leakage characteristics of the components.

H. F. Sander, Vapor Heating Corp.

Can You Answer This One? Answers will be published in the next issue.

What are the best methods for cleaning test specimens after being subjected to a fungus test (MIL E 5272A)? What are the best protective measures for personnel handling such test specimens?

H. F. Sander, Vapor Heating Corp.

(Continued from Page 12)

When the above procedure is followed, cross sensitivities of less than five per cent and ratios of lateral acceleration to applied acceleration of one per cent to fifty per cent may be determined.

If you have developed short cuts such as this one, why not share it with others in the field? Send it to the Environmental Equipment Institute, 30 Church St., New York 7, N.Y.

NEW LITERATURE

News of available new literature of interest to those in the environmental field is welcomed by the editors. Send new bulletins and/or news releases to the Environmental Equipment Institute, 30 Church St., New York 7, N. Y.

Newsletter On Microenvironment. Published periodically. Volume I; No. 2 issued August 1955. Contains names of people in field and areas in which they are working. This and subsequent copies available at $.25 each from Robert B. Platt, Chairman, Committee on Microenvironment, Ecological Society of America, Department of Biology, Emory University, Georgia.

Environmental Testing Equipment. 12-page two-color illustrated bulletin covering vacuum ovens, super vacuum systems, altitude chambers, diaphragm exercises, humidity chambers, sand and dust equipment, liquid hot and cold baths, explosion chambers, sunshine chambers, rain chambers, fungus chambers, plastic bell jar systems, salt sprays, sublimators, mobile refrigeration, immersion tests, walk-in rooms, and typical instrumentation. International Radiant Corp., Four Manhasset Avenue, Port Washington, N. Y.

Specification MIL-E-4970 (USAF), "Environmental Testing, Ground Support Equipment, General Specification For". Prescribes procedures to be followed in subjecting equipment to simulated and accelerated environmental conditions. These tests designed to insure satisfactory operation and to reduce deterioration when the equipment is operated or stored in any global locality.

(Continued on Page 20)

FIRST ANNUAL SCIENCE SECTION MEETING

by Newel Mecartney
Jack & Heintz, Inc.
Cleveland, Ohio

Chicago -- April 28, 1955. A light came on. The darkness fell back. Group thought and discussion began to illuminate the field of environmental testing.

It is a thrill to be in on the beginning of something big, and we were there -- one hundred and sixty men from over a hundred different organizations. There were those who determine the requirements and write the specifications; men involved in testing their products to these specifications; manufacturers of the test equipment; and some who are doing pure research in the field.

In a meeting of this sort, the informal discussions, the opinions and feelings, the general tenure become very important. Many items of discussion dealing with future requirements are necessarily vague; but, taken altogether, they constitute an integrated, educated guess which becomes the basis for present design of future test equipment. Product design and development must be far ahead of production; test equipment must be farther ahead of product design.

While considering the very brief descriptions of the papers which follow, it is well to remember that a period of very active and informative general discussion followed each presentation. These discussions revealed the true nature of this organization in its function as a workshop on the subject of environmental testing.

Mr. J. R. Grimm (The Environmental Criteria Branch, Wright Air Development Center) courageously presented a paper about the document which has become the primary book of law of environmental testing -- specification MIL-E-5272. He described the activities of the Environmental Criteria Branch in investigating actual conditions of altitude, temperature, and humidity which apply to aircraft now in production, and he presented some of the resulting data in graphic chart form. He discussed some of the near future requirements in explosion and vibration testing at extremes of altitude and temperatures. He noted that we may expect increased values of altitude, high temperature and vibration frequency and acceleration. Mr. Grimm made available a comprehensive list of government publications on Environmental Criteria which had been prepared by the Environmental Cri eria Branch.

We saw a film describing that fabulous facility at Eglin Air Force Base in Florida -- the Climatic Hanger. Here, in one tremendous structure, several aircraft and hundreds of lesser items may be subjected to and operated in climatic conditions simulating those which exist at any time and at any point of the surface of the earth. Some of the considerations and difficulties in the design and fabrication of this facility were shown along with the outstanding features which have been provided. This film is an excellent detailed report on the Climatic Hanger.

Mr. W. L. Vandal (Supervisor -- The Environmental Laboratory -- North American Aviation, Inc.) emphasized the psychological factors involved in the design of the testing laboratory at North American Aviation, Inc. He pointed out how the use of rigid specifications for materials, finishes, and cabinet design has provided a facility in which it is easy to maintain a high standard of neatness and cleanliness. Careful consideration has been given to the design of lighting; noise and vibration have been reduced to a minimum and then isolated from personnel areas. Where possible, the equipment is designed for automatic, unattended operation; panel mounted recording and programing instruments have been used extensively. Mr. Vandal described in some detail the facilities for altitude, vibration, and acceleration testing which have been installed in or planned for this test laboratory. This paper and the accompanying slides were very interesting and informative for those who build the test equipment and those involved in the design of any type of test facility.

Mr. E. W. Harslem (Reaction Motors, Inc.) described the three portable coolers built by his company for low ambient testing of rocket motors. He presented some of the difficulties involved in the design of such large capacity equipment originally based on the use of dry ice as a sustainer and liquid nitrogen as a booster. Mr. Harslem showed the simplification of the final design which was possible when it was found that liquid nitrogen could be used alone when released directly into the heat exchangers for cooling liquids and directly into the ambient air surrounding the test piece.

Mr. W. C. Peterson (The Bristol Company) described many methods and several instruments presently used in automatic, programed control and measurement of altitude, temperature, and humidity. He also discussed the very important trends toward an increase in unattended testing and improvement in monitoring together with some of the steps which the Bristol Company is taking to provide the

(Continued on next page)

necessary instruments.

Mr. C. Earl (Alpha Electric Refrigeration Co.) described various methods of mechanical refrigeration in detail with the advantages, the disadvantages, the limitations and some of the more common applications of each. He discussed the cost of mechanical refrigeration as compared to other cooling methods involving the use of dry ice or similar materials. Mr. Earl then had the other manufacturers of mechanical refrigeration equipment join him in forming a panel and then invited questions from the floor. The resulting discussion brought out many of the limitations of various methods of providing cooling and also indicated the trend in low temperature testing.

The interest which was evident, the excellent attendance, and the wide general participation in the discussions all very strongly indicate a dire need for an organization which, by bringing together those who require the testing, those who perform the testing, those who build the test equipment, can function as a highly effective workshop of environmental testing -- such an organization is the Science Section of the Environmental Equipment Institute.

SCI. SECT. NEWS

We'd like to pass on news of the industry in this section and would appreciate receiving any news you may have about activities or developments within the field.

Second Annual Meeting

The Second Annual Meeting of the Science Section will be a two-day affair, Hank Sander, Meeting Chairman, announces. It will be held in the same location as last year, at the Chicago Sheraton Hotel, on April 19 and 20, 1956. It is planned to have seminars on the philosophy of various phases of testing and general papers on testing and test facilities. Active discussions are expected on these subjects, providing a well rounded exchange of ideas. In addition, there will be facility trips to Inland Testing Labs and one other laboratory.

News from Chicago

The following have shown interest in the formation of a Chicago Science Section: James Hall, Fansteel; Jack Ashford, Bendix Products; R. Johnson, Barber-Coleman; F. Wunder, Armour Research Foundation; James Rinke, Potter and Brumfield; Steve Danko, Motorola Radio. Anyone interested in forming such a group, and attending monthly meetings in the Chicago area, contact Hank Sander, Vapor Heating Corporation, 6420 W. Howard St., Chicago 31, Ill., NE 1-9200.

Look This One Up

Our attention is called to an article in the May 1955 issue of Nation's Business, entitled "Aviation Assaults the Heat Barrier". This article pertains to the future for environmental equipment.

New York Plans November Meeting

A New York metropolitan local meeting will be held Thursday, Nov. 10, 1955. Dinner at 6:30 pm, meeting to start at 7:30. Place will be the Famous Kitchen, 318 W. 45 St., N.Y.C. Mr. Harold C. Jones, Senior Engineer, Westinghouse Air Arm, Baltimore, Maryland, will speak on "The Philosophy of Environmental Testing." There is no charge for the meeting. For further information contact Roger Amorosi, Parameters, Inc., 195 Herricks Road, Garden City Park, N. Y., Pioneer 6-0155.

Monroe Seligman, left, outgoing president of EEI, congratulates E.D. McAuliffe, incoming president at the First Annual Science Section Meeting, April 1955.

West Coast Active

Hank Sander, Vapor Heating Corp., Chicago, visited Bill Vandal, North American Aviation, Downey, Cal., in the first part of Sept. and discussed progress of EEI Science Section on the West Coast. It is felt that a large potential is available due to the vast amount of testing done in this area.

Looking Ahead

A survey has just been completed for the Westinghouse Air Arm Division to predict the long range (five to ten years) needs of environmental test facilities at their Friendship Airport, Md., plant. The survey was conducted by the York Corporation and Tenney Engineering in preparation for the acquisition of a 3000-cu-ft all-weather facility by Westinghouse.

(Continued from Page 13)

neighborhood of 1500 CFM. Assuming the simulation of an altitude of 100,000 ft and a temperature of approximately -85F, the approximate reduction in absolute pressure of 100 to 1 would necessitate an equivalent increase in air handling capacity; that is, 150,000 CFM.

The size and cost of equipment required to produce the above altitude conditions, by means other than embossed panels, are considerable. Some of the units that have been built without embossed panels have been tremendous in size, with relatively small working space, and have had difficulty in providing uniform temperatures and quick pulldowns.

The metal of embossed panels is in direct contact with the refrigerant, and also with the reinforcing members welded to them. This allows transfer from this large mass of steel and the adjacent insulation by conduction with a very rapid drop in temperature. Also, the panels provide simulation of skin friction temperatures, such as those encountered under supersonic flight conditions. A chamber presently is being designed where the side walls and ceiling are to be maintained at -100F, while the floor will be held at 160F. Embossed plates make these requirements a practical design problem.

The growth in the use of embossed plates in the construction of environmental test equipment is, of course, attributable to the advantages that these units provide. The relative youth of this type of surface is providing an opportunity for the development of new and better ways to solve heat exchange problems in environmental equipment.

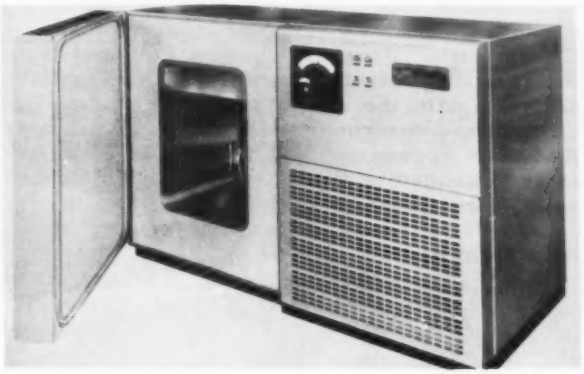
NEW PRODUCTS

News of product developments are welcomed by the editors. Send releases to the Environmental Equipment Institute, 30 Church St., New York 7, N. Y.

New small-size, low-cost chamber performs multiple functions in labs and medium sized shops. It operates as a low or high-temperature testing unit, bath or laboratory oven. Having an interior capacity of 1-1/2 cu ft, it is recommended for metal treating and tool chilling, for testing instruments and electronic components, and for pharmaceutical storage and preservation.

Three low-temperature ranges are available: -40F, -100F, and -120F. Reported pulldown on the basic -100F model is approximately 60 minutes.

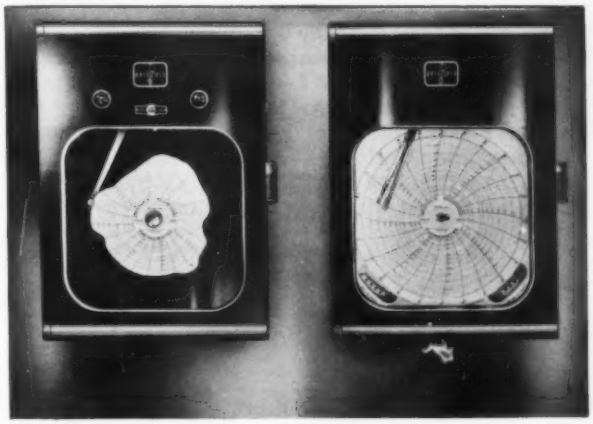
The chamber operates on 110-volt, 60-cycle circuits; is available with top or front opening door. Swivel casters may be added to make the unit mobile.



Complete specifications and performance data on the new "Tenney-Mite" are available from Tenney Engineering, Inc., 1090 Springfield Road, Union, N. J.

A complete line of control instruments has been announced for use with environmental test cabinets. These instruments can be used to initiate and maintain an entire program of varying climatic conditions within the test cabinet, and to simulate any desired temperature, humidity, or altitude conditions.

The program controllers, available in one or two case models depending on the ap-



plication, will carry through the program repeatedly and reproduceably. They can also be used to bring temperature, pressure, or vacuum up to any desired value and maintain it there for a predetermined length of time.

(Continued on Page 20)

NEW LITERATURE

(Continued from Page 16)

USAF Specification Bulletin No. 115, "Environmental Criteria for Ground Support Equipment". Presents in a consolidated form the most important design parameters that are known to date; the effects of various factors of climate and environment; and design methods that have proven helpful in meeting these effects. Intended to acquaint designers of ground support equipment with the fact that primary consideration must be given to factors of environment early in design.

NEW PRODUCTS

(Continued from Page 19)

Accuracy of control is 1/2% of full scale value. Available with electric on-off or proportional-input control, or with pneumatic control in proportional, reset, or derivative modes, the instruments can be adapted to any model test cabinet. The two-case models can be mounted one above the other or side by side to suit the requirements of the cabinet.

A plastic or aluminum cam serves as a template for the program. The cam can be changed in a matter of seconds for another cut to a different program. This allows a complete change in the program maintained by the cabinet. No skilled labor is required to make the change.

Further information is available from The Bristol Company, Waterbury 20, Conn.

First built as a special unit for testing laboratories, a new 2-cu.ft. low-temperature chilling machine now is being furnished as a standard model for research laboratories, testing and biological centers, heat treating laboratories, industrial test departments and similar users whose volume requirements are low.

The new model has a clear opening of $21\frac{1}{2}$" x $10\frac{1}{2}$". The chilling chamber size is 24"

x 12" x 12" deep. Overall size of unit is 43" high, 32" long and 20" deep. At -120F the machine has a net thermal capacity of 400 Btu's/hr.

Standard accessories available include a 500-watt heater (provides chamber temperature of 200F), fan for rapid cooling or heating, observation windows in top or front, interior lights, entrance holes, electrical connections within the chamber, and instrumentation as required.

Information on model A-120-2 is available from Cincinnati Sub-Zero Products, 3930 Reading Road, Cincinnati 29, Ohio.

CLASSIFIED ADS

Classified Ads will be carried at the rate of $1 per line. Address ads to Environmental Equipment Institute, 30 Church St., New York 7, N. Y.

Westinghouse Air Arm division has openings in its environmental evaluations group for engineers with experience in: climates, vibrations, cooling, airborne electronics, and hydraulics. Work covers development and evaluation of avionics systems and components under simulated environmental conditions. For further information contact Mr. Robert H. Lake, Engineering-Industrial Relations, Westinghouse, Air Arm Division, Friendship International Airport, Baltimore, Md.

. . . LOW COST Full-Range Temperature-Humidity Cabinet

Answers the need for a readily-available environmental test tool that meets JAN, MIL and all above-freezing gov't. specifications. Automatically controls or programs dry and wet bulb conditions for checking product performance under extreme tropical or desert conditions. Typical HUDSON Bay® stainless steel construction with many plus features.

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A completely preassembled altitude simulation Walk-In room, ready for installation, was recently delivered to the Italian Air Ministry in Rome. The Italian government and its pioneer aircraft manufacturers are now being called on to assist in the production of jets for world defense. For thorough testing of vital instrumentation and electronics devices, the Italian government depends on Bowser.

In Baltimore the Electronics Division of Westinghouse tests equipment under extreme atmospheric conditions simulated in an automatically controlled Bowser Walk-In room.

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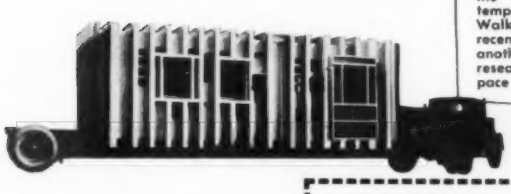

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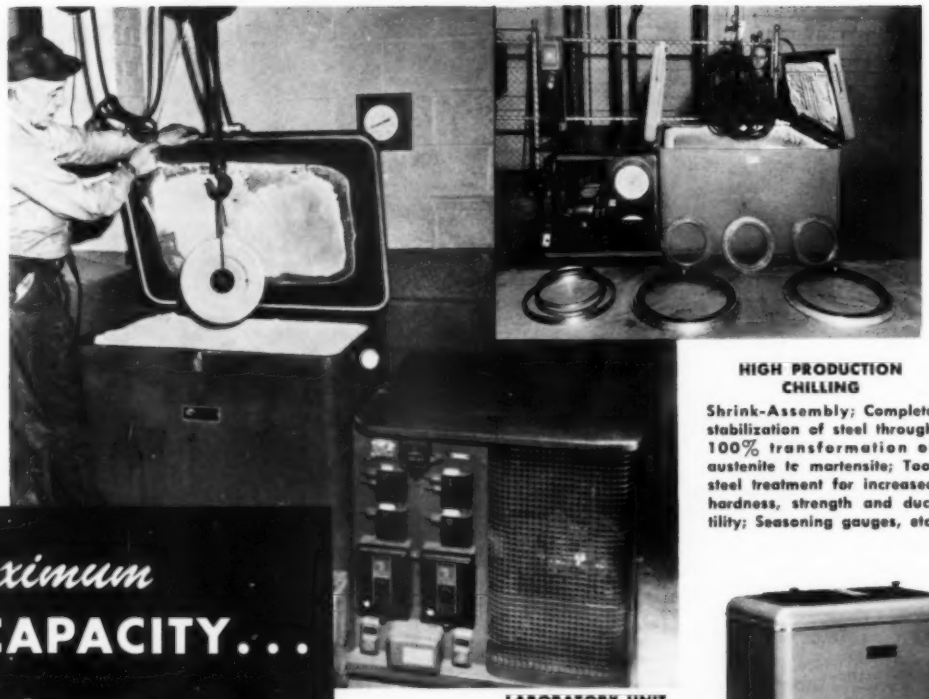

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for low-cost production chilling

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Model A-120-2. 2 cubic feet chamber size, with thermal capacity of 400 B.t.u.'s per hour at —120° F.
For testing and storage at low temperatures . . . experimental applications where moderately small capacity is needed.

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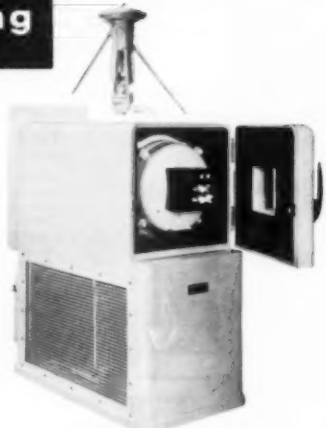
Specially-built, custom-designed units for specific programs, including hot and/or cold cycling under various pressures and selected conditions. Fully automatic controls. Completely flexible. Many combinations at preset time intervals.



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Complete line for simulation of any combination of conditions. High and low temperatures, varying relative humidities, altitudes up to many thousands of feet . . . for product or packaging tests under special conditions.

HIGH AND LOW TEMPERATURE TESTING

Low temperature units may also be equipped with accessory devices for temperatures as high as +250° F. for alternate processing or testing of high and low temperature within a single cabinet. Provisions for higher temperatures can be supplied.

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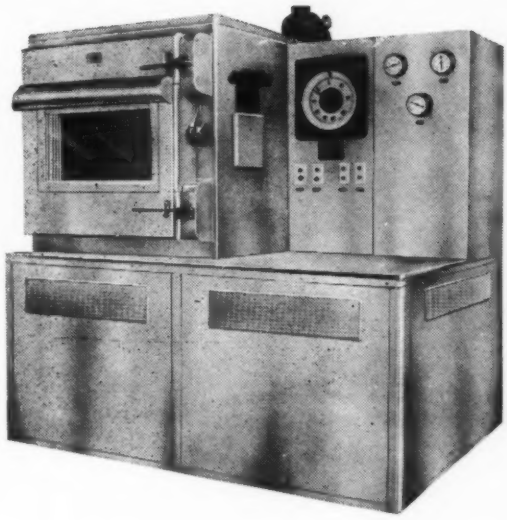

HIGH & LOW TEMPERATURES

CONTROLLED HUMIDITY

- **—150°F. to +200°F.**
- **20% to 95% R.H.**
- **1 cu. ft. to 75 cu. ft. cabinets**

Walk-in Rooms
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Electronic or pneumatic recording or indicating control systems

CUSTOM CHAMBERS
built to specifications.

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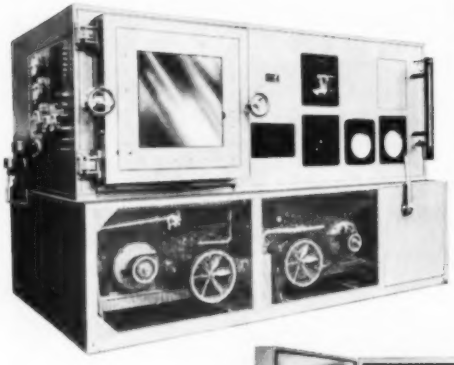


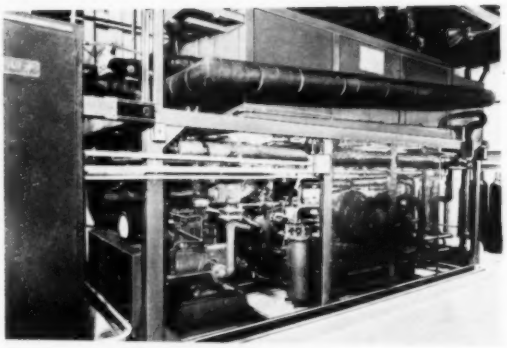
A L T SERIES

Completely automatic operation for testing under conditions of:

ALTITUDE (sea level to 80,000 feet & higher)

TEMPERATURE (from +500°F to −100°F & lower)

HUMIDITY (from 20% to 95%)



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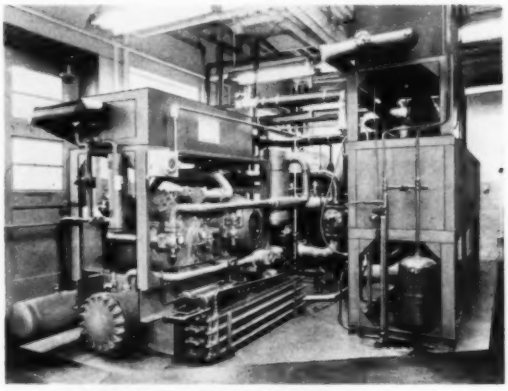

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Conditions any liquid — fuel, corrosive or non-corrosive — to simulate accurately operating PRESSURES (to 1000 psi or higher)

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Liquid flow to 100,000 lbs./hour.

American Research Corp. is continuously developing and improving environmental testing facilities to provide more versatile operations and to meet the latest government specifications.

These units include Sand and Dust, Explosion, Rain and Sunshine, Fungus, Central Brine Systems, etc.

Write for catalog or consultation with AR'S experienced field engineers regarding your special requirements.

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Two Types
"F" Series — Front Opening
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Range:
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Size:
4 cu. ft. to 72 cu. ft.

HUMIDITY AND TEMPERATURE CABINETS

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Humidity:
10% to 97%
Controlable above a 35° F. D.P.

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Temperature:
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Altitude:
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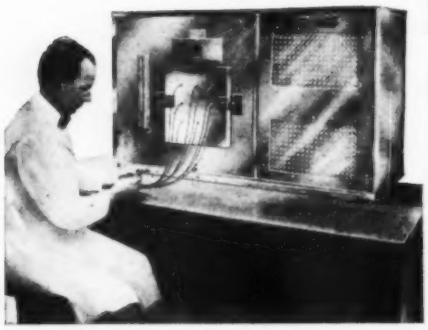
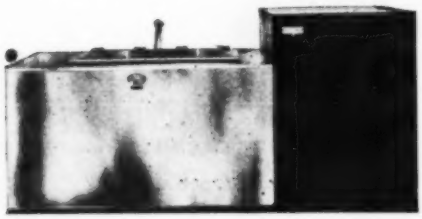
makes it!



Webber High-Low Temperature Bench Unit



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From the smallest testing units to large capacity industrial cabinets there's a WEBBER Low Temperature Unit to fit your needs and applications. Units with temperatures to -185° F. are available with heat cycling, humidity and vacuum for testing.

Industrial Units are made in a variety of sizes and shapes. Its custom equipment at standard equipment costs. Special patented features assure faster heat removal, low cost operation and safety factors.

For low-temperature equipment . . . for guaranteed dependability and performance . . . *see* WEBBER.

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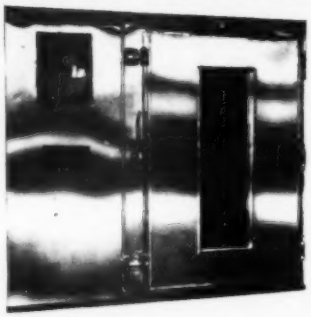
features of Webber Environmental Test Unit!



Webber designed *fully automatic control* of temperature *and* humidity into this test unit for Westinghouse Electric Corp., Pittsburgh.

While this unit required control from —80 F. to +200 F. and 20%-90% relative humidity, Webber can provide a complete *high-low* temperature and humidity control range. Webber designs and manufactures a full line of Standard Environmental Test Units, as well as special application equipment.

If you have an Environmental Test problem of *any* kind, Webber Engineers *want* to be of service to you. Send coupon for brochures on new Chest-Type Unit and Environmental Test Equipment.

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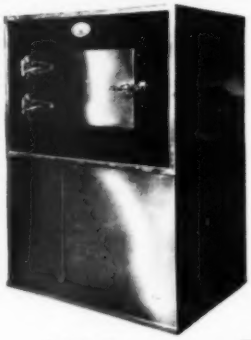
WEBBER CASE HISTORY — **No. 286** LANSDALE TUBE CO.

Automatic Cycling

with temperature range from —100f to —200f

. . . helps Lansdale Tube Company produce quality radio and television tubes



Webber designed and built this Environmental Test Unit to rigid customer specs. Extreme accuracy was required in controls automatically changing temperature from —80F to +185F and return—on an hourly cycle.

Webber manufactures a complete line of standard Environmental Test Units, featuring high-low temperature range and optional humidity control. Webber designs *all* types of special Environmental Test Equipment, and manufactures it to *your* specifications.

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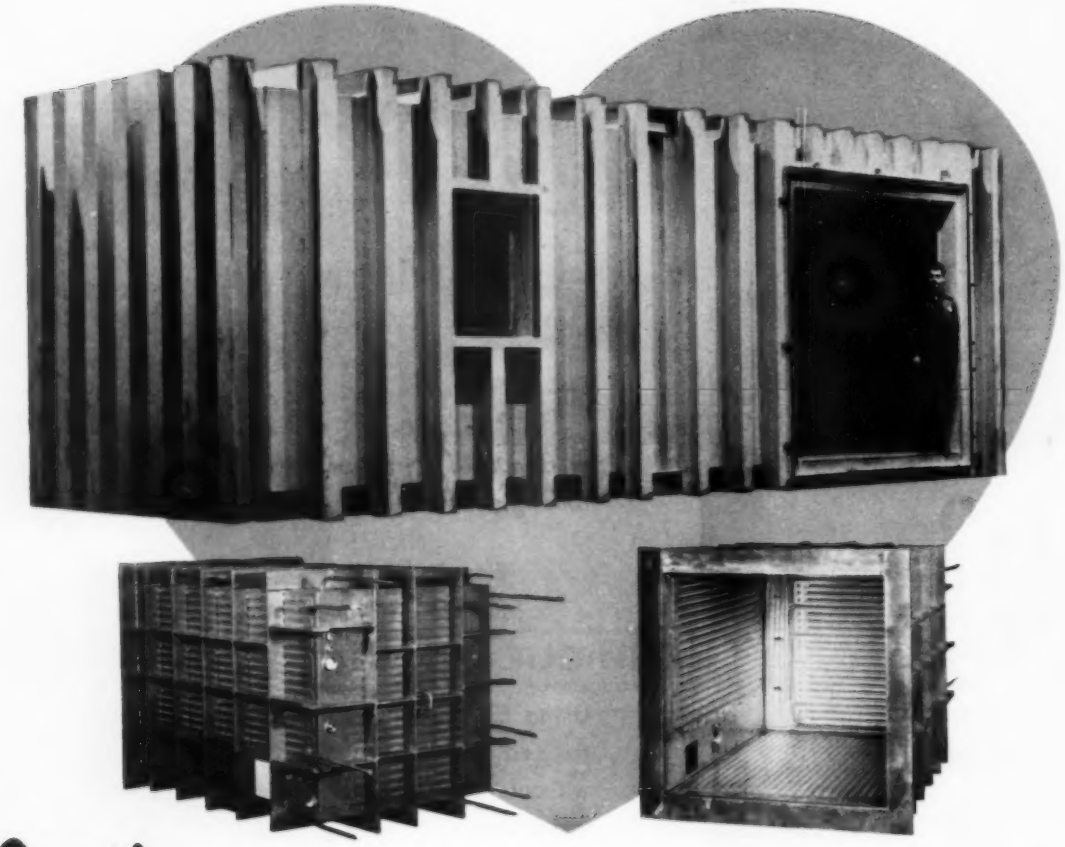

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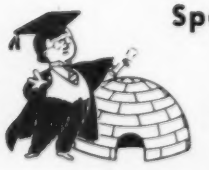

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